

Seven new species of *Macrozamia* section *Parazamia* (Miq.) Miq. (Zamiaceae section *Parazamia*) from Queensland

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Summary

Jones, David L. & Forster, Paul I. (1994). Seven new species of *Macrozamia* section *Parazamia* (Miq.) Miq. (Zamiaceae section *Parazamia*) from Queensland, *Austrobaileya* 4(2): 269–288. Seven new species of *Macrozamia* section *Parazamia* (Miq.) Miq. from south-east Queensland are described and illustrated. They are *M. conferta*, *M. cranei*, *M. crassifolia*, *M. machinii*, *M. occidua*, *M. parcifolia*, and *M. viridis*. All are restricted endemics allied to either *M. plurinervia* (L.A.S. Johnson) D.L. Jones or *M. pauli-guilielmi* W. Hill & F. Muell. A key to the species of *M.* section *Parazamia* in Queensland is presented.

Keywords: Zamiaceae section *Parazamia*; *Macrozamia*-Queensland; *Macrozamia conferta*; *Macrozamia cranei*; *Macrozamia crassifolia*; *Macrozamia machinii*; *Macrozamia occidua*; *Macrozamia parcifolia*; *Macrozamia viridis*; *Macrozamia plurinervia*; *Macrozamia pauli-guilielmi*.

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Introduction

The genus *Macrozamia* Miq. (Zamiaceae) is currently being revised by the senior author. The species that occur in Queensland are being revised jointly by the current authors in preparation for that revision. Three precursor papers on the genus have been published (Forster & Jones 1992, Jones 1991, Jones & Hill 1992) and here, seven new Queensland species of *Macrozamia* are described in *M.* section *Parazamia* (Miq.) Miq. All excepting *M. machinii* and *M. viridis* have been discovered within the last eight years and recent collections of fertile material have established them as new. Most of the new species are currently listed on the schedule of rare or threatened flora for Queensland (Forster 1994) and their naming facilitates management and conservation programs for their survival.

As with other cycad genera, e.g. *Cycas* (Hill 1992), *Ceratozamia* (Stevenson *et al.* 1986), *Dioon* (Sabato & De Luca 1985), *Encephalartos* (Heenan 1977, Robbertse *et al.* 1988, 1989) and *Zamia* (Stevenson 1993), speciation in *Macrozamia* has occurred where populations have become geographically iso-

lated over long periods of time. The new species are narrowly endemic, being mostly represented by more than one population. These populations generally exist in close proximity (being less than 100 km apart) and in similar habitats.

Macrozamia section *Parazamia* comprises small to relatively small plants with a subterranean caudex which may be unbranched or branched, leaves usually spirally twisted, the lower leaflets not reduced and spine-like and an absence of mucilage canals in the leaflets (Johnson 1959). Two complexes dominate *M.* section *Parazamia* in Queensland:-

(1) The *M. plurinervia* complex, based on *M. plurinervia* which itself is restricted to northern New South Wales. Taxa have moderately broad to broad, usually shallowly concave leaflets. Seven species occur in the Darling Downs and Leichhardt districts of southern Queensland. These species are as follows -

M. conferta, restricted to ranges near Warwick in the Darling Downs district.

M. cranei, restricted to the Texas area in the Darling Downs district.

M. fearnsidei, restricted to the Injune area in the Leichhardt district.

M. machinii, restricted to the Inglewood area in the Darling Downs district.

M. occidua, restricted to the Sundown area in the Darling Downs district.

M. platyrhachis, restricted to the Blackdown Tableland in the Leichhardt district.

M. viridis, restricted to the Girraween area in the Darling Downs district.

(2) The *M. pauli-guilielmi* complex, based on *M. pauli-guilielmi* which is restricted to the Wide Bay district of south-east Queensland. Taxa in this complex have very narrow, deeply concave leaflets. Three species occur in the Wide Bay and Burnett districts of Queensland. All occupy specific habitats. These are -

M. crassifolia, restricted to the Mundubbera - Eidsvold area in the Burnett district.

M. parcifolia, restricted to the Biggenden area in the Wide Bay district.

M. pauli-guilielmi, restricted to the Wide Bay district, growing mainly in coastal lowlands.

A revision of the *M. miquelii* (F. Muell.) A. DC. species complex (*M.* section *Macrozamia*) will be presented in a future paper.

Materials and Methods

All species dealt with in this paper were examined in the field. Measurements cited here were made from both living and dried material. Examination of stomatal arrangement and venation was carried out on sections of pinnae cleared in lactophenol.

Conservation codings for the species are as recommended by Briggs & Leigh (1988). Cycad popularity throughout the world has imposed tremendous pressures on natural populations, to the extent that a significant number of species have become nearly extinct in the wild, particularly in South Africa, Mexico, Central America and South America (Jones 1993, Vovides 1986). The situation in Australia is not yet critical but poaching of plants from the wild for profit is a reality that must be faced. For this reason localities cited in this

paper are general rather than specific, in line with the actions of other cycad botanists (e.g. Stevenson 1990, 1993).

Specimens of known sex are cited as A (female) or B (male) following the collector's number.

Terminology

Morphological terminology basically follows that of Johnson (1959) except that peduncle is used in place of cone-stalk, microsporophyll in place of male sporophyll and megasporophyll in place of female sporophyll. Stem measurements are taken at the widest point. Measurements of leaflets are taken at the mid-point of the lamina. Measurements of the male and female cones and their peduncles are taken separately, with the width of the cones measured at the widest point. Microsporophyll and megasporophyll measurements are taken from those organs at the widest part of the cone. Seeds are normally somewhat angular from pressures exerted in the developing cone and measurements are taken from the longest length and the widest diameter. Preliminary studies indicate that patterns on the chalazal end of the seed may have some diagnostic use and this feature is included in the drawings for each species. This character needs to be explored further for its usefulness.

Taxonomy

Critical comparative measurements in this paper are made between the new taxa and either *M. plurinervia* or *M. pauli-guilielmi*. Neither of these taxa is detailed in this paper but to facilitate comparisons of pertinent dimensions in the new taxa the following abbreviated descriptions are included.

M. plurinervia: Caudex more or less ovoid, 20–30 cm diam., subterranean, branched with up to 12 growths in a complex clump. Young leaves glaucous, glabrous. Mature leaves 85–115 cm long, grey-green to green, dull, glabrous, erect, 5–7 in a sparse to moderately dense crown. Leaflets linear, 10–30 cm long, 4–9 mm wide, green to grey-green above, dull, strongly glaucous beneath, arising at 50–70 degrees to the rhachis, obliquely erect to

spreading, hypostomatic, concave adaxially in cross-section, thick-textured, 110–180 per leaf; callous base yellow to orange. Male cones 18–28 cm × 4–6 cm, strongly glaucous; peduncle 15–20 cm × 2–2.5 cm.; microsporophylls cuneate, 1.8–2.3 cm × 1.5–1.8 cm; spines to 1.5 cm long. Female cones 15–23 cm × 6–9 cm, glaucous; peduncle 12–17 cm × 2–2.5 cm; megasporophylls with stipe 3–4 cm long, the outer face 3.5–4.5 cm × 1–1.5 cm; spines to 2.5 cm long. Seeds broadly ovoid to oblong-ellipsoid, 2.5–3 cm × 2.3–2.6 cm.

M. pauli-guilielmi: Caudex more or less ovoid, 10–20 cm diameter, subterranean, branched with up to 19 growths in a clump. Young leaves bright green glabrous. Mature leaves 60–90 cm long, dark green, dull, glabrous, erect, 1–6 in a sparse crown. Leaflets narrowly linear, 15–40 cm × 2.3–4 mm, dark green, dull on both surfaces, arising at 20–45 degrees to the rhachis, widely spreading, recurved in the distal half, hypostomatic, deeply concave adaxially in cross-section, moderately thick-textured, 130–190 per leaf; callous base cream to white. Male cones 8–14 cm × 3.5–5 cm; peduncle 8–12 cm × 1.5 cm; microsporophylls cuneate, 1.4–1.8 cm × 0.8–1.1 cm; spines vestigial to 0.8 mm long. Female cones 9–12 cm × 5–6.5 cm; peduncle 10–13 cm × 1.5–2 cm; mega-sporophylls with stipe 1.5–2.2 cm long, the outer face 2.5–3 cm × 1–1.4 cm; spines to 2.5 cm long. Seeds obovoid, 2–2.5 cm × 1.5–2 cm.

1. *Macrozamia conferta* D. L. Jones & P. I. Forst. *sp. nov.* *M. plurinerviae* (L.A.S. Johnson) D. L. Jones affinis, sed foliis juvenilibus sericeis, foliis maturis brevioribus foliolis angustioribus prasinis confertis, strobilis minoribus, et seminibus multo minoribus, differt. **Typus:** Queensland. DARLING DOWNS DISTRICT: near Warwick, 20 Apr 1992, *P.I. Forster* 9800B & *P. Machin* [male plant] (holo: BRI [2 sheets & carpological]; iso: CBG).

Macrozamia sp. (Warwick K. Hill 3825); Forster (1994).

Mature caudex more or less ovoid, 15–30 cm diameter, subterranean, each plant branched with up to 12 growths in a clump. Young leaves sericeous on the rhachis and petiole. Mature

leaves 35–60 cm long, dark green, shiny, glabrous with age, erect, 1–5 in a sparse crown; expanded leaf base 6–10 cm long, 1.2–2.3 cm wide, densely covered with light fawn, soft wool; petiole (including the woolly expanded base) 7–21 cm long, 7–12 mm wide at the first leaflet, dark green, dull, with adaxial surface flat to slightly convex and abaxial surface strongly convex; rhachis spirally twisted 2–3 times, dull dark green, in cross-section similar to that of the petiole. Leaflets linear, 6–30 cm long, 2–6 mm wide, arising at 30–60 degrees to the rhachis, obliquely erect, hypostomatic, bright green and shiny on both surfaces, concave adaxially in cross-section, moderately thick-textured, not twisted except at base, 90–160 per leaf, arranged more or less in 2 ranks but not always in opposite pairs, crowded (1–17 mm apart), the longest leaflets found towards the middle of the leaf with distal and proximal leaflets shorter; apex asymmetrically acuminate; callous base greenish to greenish-yellow, rarely reddish. Male cones more or less cylindrical, 7–18 cm × 2.5–4 cm, straight or slightly curved with age; peduncle 4–18 cm × 1.5–2 cm, circular to elliptical in cross-section; microsporophylls narrowly cuneate to reniform, 0.9–1.7 cm × 0.7–1.6 cm, most with vestigial spines, a few distally with stiff, pointed spines to 0.5 cm long. Female cones more or less ovoid to ovoid-cylindrical, 6–12 cm × 3.5–6 cm, erect; peduncle 10–15 cm × 1–2.0 cm, elliptical in cross-section, furrowed, often twisted, densely woolly; megasporophylls with stipe 1.7–2 cm long, the outer face transversely ovate to reniform, 2.4–3.2 cm × 0.6–1.2 cm, with a prominent depression just below the apical spine; spines increasing in length towards the apex of the cone, the longest c. 1 cm long. Seeds ovoid to oblong-ovoid, 2–2.5 cm × 1.6–2 cm, the sarcotesta red when ripe. **Figs 1, 8B.**

Selected specimens: Queensland. DARLING DOWNS DISTRICT: near Warwick, May 1992, *Jones* 9357 & *Jones* (BRI, CBG, NSW); ditto., Sep 1992, *Forster* 11705A & B & *Machin* (BRI, CBG); ditto., Jan 1993, *Forster* 12711A & *Machin* (BRI), ditto 12711B (BRI, CBG); Apr 1992, *Forster* 9800A & *Machin* (BRI, CBG); ditto., Sep 1992, *Forster* 11727A (BRI), ditto 11727B & *Machin* (BRI, CBG).

Distribution and habitat: *M. conferta* is restricted to two State Forests in the Darling

Downs district near Warwick. In one site the plants grow in ash-grey to white, floury, silty loam in flat terrain or on low ridges, whereas the second site is hilly with steep slopes and grey-white, skeletal soils. Here the cycads form open colonies at altitudes between 600 and 750 m, in open forest communities dominated

by *Eucalyptus maculata* Hook., *E. fibrosa* F. Muell., *E. melliodora* A. Cunn. ex Schauer, *E. crebra* F. Muell. and *E. moluccana* Roxb. Associated understorey species include *Acacia lineata* A. Cunn. ex G. Don, *A. fimbriata* A. Cunn. ex G. Don, *Jacksonia scoparia* R. Br. and *Melichrus urceolatus* R. Br.

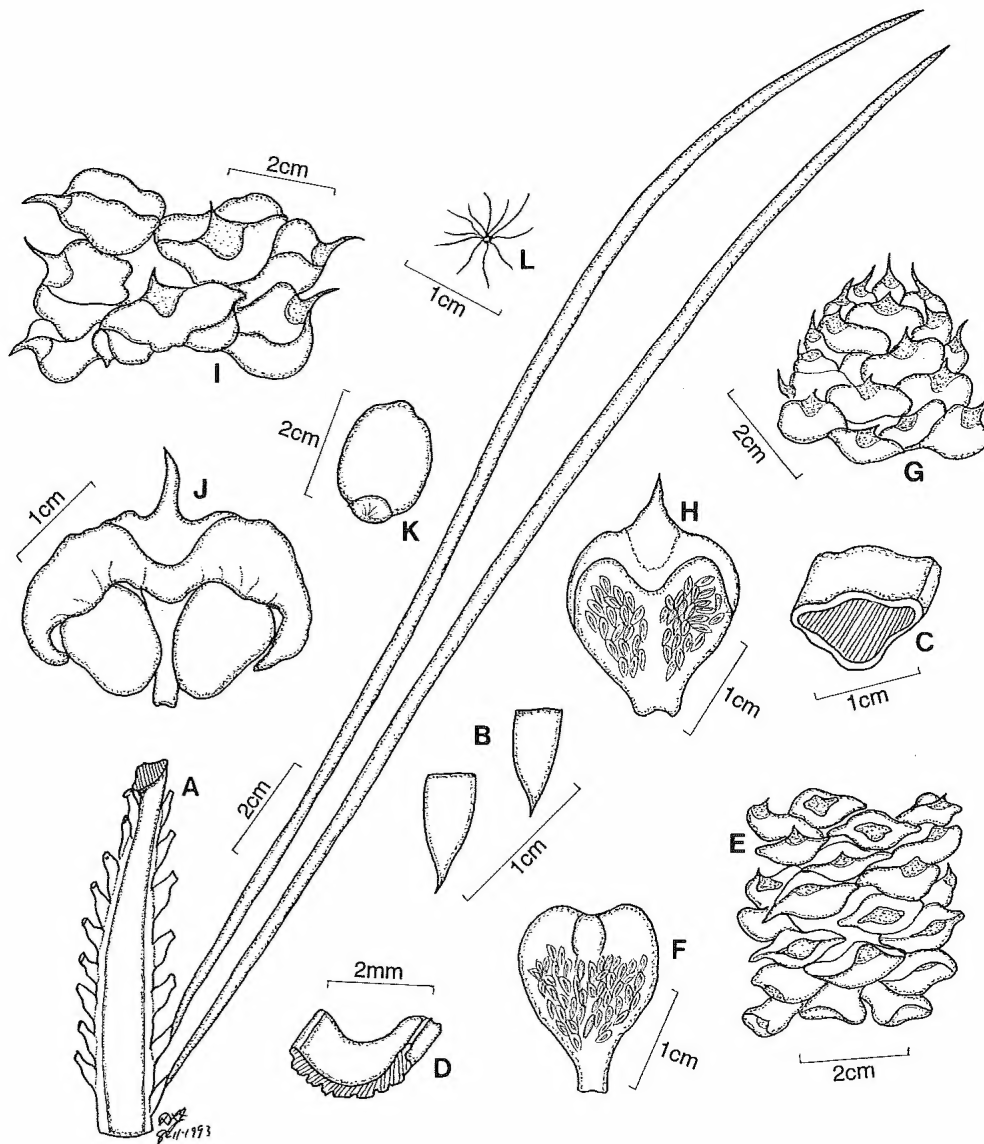


Fig. 1. *Macrozamia conferta*. A. portion of rhachis and two leaflets. B. tips of leaflets. C. TS of rhachis. D. TS of leaflet. E. basal portion of male cone. F. microsporophyll (abaxial view) from basal portion of cone. G. apical portion of male cone. H. microsporophyll (abaxial view) from apical portion of cone. I. portion of female cone. J. megasporophyll (abaxial view). K. seed. L. pattern on chalaza end of seed. From Jones 9357 & Jones (CBG) and Forster 9800A & Machin (BRI).

Phenology: Cones mature October–November; seeds ripen February–March.

Notes: This species appears to have been discovered in 1987 by A. R. Bean while collecting eucalypts near Warwick, but no specimens were lodged in any herbarium. *Macrozamia conferta* has the smallest habit of the Queensland cycads and is notable also for its leaves with very crowded leaflets. It is allied to *M. plurinervia* but is readily distinguished from that species by its much narrower, bright green, shiny, crowded leaflets, the much smaller, green cones and much smaller seeds.

Conservation status: Locally common but vulnerable to poaching; a conservation coding of V, was given by Forster (1994).

Etymology: The specific epithet is derived from the Latin *confertus* and alludes to the crowded leaflets of the leaf.

2. ***Macrozamia cranei*** D. L. Jones & P. I. Forst. **sp. nov.** affinis *M. plurinerviae* (L.A.S. Johnson) D. L. Jones, sed caudice non ramoso, foliis atrovirentibus supra nitentibus infra pruinosis, strobilis multo minoribus non-glaucis et seminibus minoribus ovoideis usque oblongis differt. **Typus:** Queensland, DARLING DOWNS DISTRICT: near Texas, 25 Sep 1992, P.I. Forster 11593B, P. Machin & R. Crane [male plant] (holo: BRI [2 sheets & carpological]; iso: CBG).

Macrozamia sp. (Texas R. Crane 741); Forster (1994).

Caudex more or less ovoid, 10–25 cm diameter, subterranean, unbranched. Young leaves sericeous on the rhachis and leaflet bases and glabrous and strongly pruinose on the leaflets. Mature leaves 70–90 cm long, erect, dark green, shiny, glabrous with age, 1–5 in a sparse crown; expanded leaf base 6–13 cm × 1.0–2.5 cm, densely covered with fawn to grey-brown, soft wool; petiole (including the woolly expanded base) 15–31 cm long, 7–12 mm across at the first leaflet, dark green, shiny, with adaxial surface slightly convex and abaxial surface strongly convex; rhachis spirally twisted 3–6 times, dark green, the cross-section similar to

that of the petiole. Leaflets linear, arising at about 50 degrees to the rhachis, obliquely erect to widely spreading, often with drooping tips, 7–30 cm × 2–7 mm, hypostomatic, dark green and shiny above, dull and pruinose-glaucous beneath, shallowly concave adaxially in cross-section, moderately thick-textured, not twisted except at base, 100–150 per leaf, arranged more or less in 2 ranks but not always in opposite pairs, moderately crowded (4–30 mm apart), the longest leaflets found towards the middle of the leaf, distal and proximal leaflets shorter, apex asymmetrically acuminate, with a yellow mucro; callous base greenish to greenish-white, rarely reddish, inconspicuous. Male cones more or less cylindrical, 8–22 cm × 2.5–5.5 cm, straight or curved with age; peduncle 8–22 cm × 1.3–2 cm, elliptical to round in cross-section; microsporophylls narrowly- to broadly-cuneate, 1.5–2 cm × 1.3–2 cm, those in the proximal half to two-thirds of the cone with vestigial spines, distal ones with stiff, pointed spines to 1 cm long. Female cones ovoid, 8–13 cm × 4.5–5.5 cm, erect, green; peduncle 12–20 cm × 1.2–2.1 cm, elliptical in cross-section, furrowed; megasporophylls with stipe 1.7–2.5 cm long, the outer face transversely ovate, 2–4 cm × 1.5–2 cm, with a prominent depression just below the apical spine; spines increasing in length towards the apex of the cone, the longest c. 1.5 cm long. seeds ovoid, 2–2.5 cm × 1.8–2.2 cm, the sarcotesta orange to red when ripe. **Figs 2, 9B, 10D.**

Selected specimens: Queensland. DARLING DOWNS DISTRICT: [all from type locality] Jun 1992, Crane 741 (BRI, CBG); Sep 1992, Forster 11593A, Machin & Crane (BRI, CBG); 11611 (BRI, CBG); 11619 (BRI, CBG); Jan 1993, Forster 12694 & Machin (BRI); Apr 1993, Jones 11525, et al (CBG, NSW).

Distribution and habitat: *M. cranei* is restricted to a small area of rugged terrain near Texas in the Darling Downs district and grows at 400–600 m altitude. Plants occur in small colonies on steep ridges in shallow, skeletal soil or on alluvium along ephemeral watercourses, both soil types associated with limestone outcrops. The vegetation where they occur is either open forest dominated by *Eucalyptus* species or fragmented semi-evergreen vine thicket.

Phenology: Cones mature October–February; seeds ripen February–March.

Notes: This species was discovered by R. Crane in May 1992. It is allied to *M. plurinervia* but can be distinguished from that species by its non-branching caudex, the leaflets which are dark green and shiny on the upper surface and

strongly pruinose-glaucous beneath, smaller, green cones and smaller seeds. It is also very close to *M. occidua* but differs from that species by its longer leaves, longer, shiny leaflets and green cones.

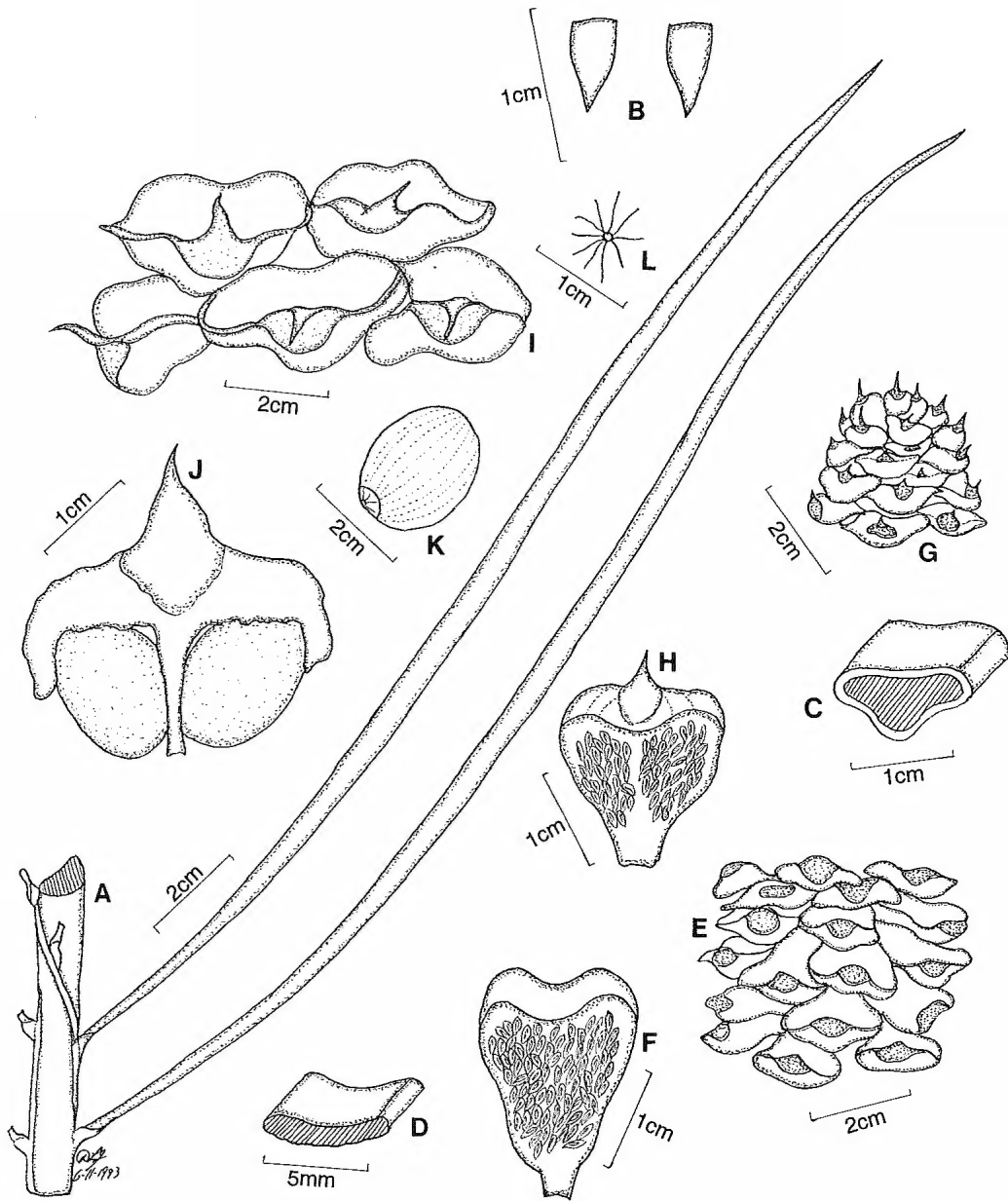


Fig. 2. *Macrozamia cranei*. A. portion of rhachis and two leaflets. B. tips of leaflets. C. TS of rhachis. D. TS of leaflet. E. basal portion of male cone. F. microsporophyll (abaxial view) from basal portion of cone. G. apical portion of male cone. H. microsporophyll (abaxial view) from apical portion of cone. I. portion of female cone. J. megasporophyll (abaxial view). K. seed. L. pattern on chalaza end of seed. From Jones 11525 *et al.* (CBG) and Forster 11593A, Machin & Crane (BRI).

Conservation status: Of restricted occurrence on private land and poorly known. A conservation coding of V was given by Forster (1994).

Etymology: Named for Ralph Crane who brought the species to our attention; a builder by trade, he is an amateur orchidologist who has contributed over 700 herbarium specimens of Orchidaceae to BRI and CBG.

3. *Macrozamia crassifolia* P. I. Forst. & D. L. Jones **sp. nov.** *M. pauli-guilielmi* W. Hill & F. Muell. affinis, sed foliolis textura multo crassiore obscura atro-virentibus, foliolis basi callosis minus conspicuis, et strobilorum masculorum et femineorum sporophyllis majoribus, differt. **Typus:** Queensland. BURNETT DISTRICT: Mundubbera, 10 Jan 1992, *P.I. Forster* 9384B & *P. Machin* [male plant] (holo: BRI [3 sheets, carpological & spirit]; iso: CBG).

Macrozamia sp. (Mundubbera P.I.Forster 4674); Forster (1994).

Caudex more or less ovoid, 10–20 cm diameter, subterranean, branching with up to 4 caudices in a clump. Mature leaves 50–110 cm long, dark green, erect, 1–5 in a sparse crown; expanded leaf base 5–16 cm × 1–2.5 cm, densely covered with thick, brown, felty wool; petiole (including the woolly expanded base) 5–26 cm long, dark green, dull, 7–20 mm across at the first leaflet, flat to slightly convex on the adaxial surface and strongly convex abaxially; rhachis spirally twisted 1–4 times, dark green with white markings between the bases of the leaflets but not in a continuous band, the cross-section similar to that of the petiole. Leaflets narrowly linear, arising at about 45 degrees to the rhachis, porrect to arcuate, drooping in the distal third, 15–55 cm × 2–3.5 mm, hypo-stomatic, dark green and dull above, bright green beneath, strongly concave adaxially in cross-section, thick-textured, not twisted, 104–172 per leaf, arranged more or less in 2 ranks but not always in opposite pairs, crowded (3–24 mm apart), the longest leaflets found towards the middle of the leaf, distal and proximal leaflets shorter, apex acuminate; callous base white to greenish-white. Male cones more or less cylindrical, 10–16 cm × 3–4.5 cm, straight or curved with

age; peduncle 10–16 cm × 1–1.4 cm, elliptical in cross-section; microsporophylls broadly cuneate, 1.7–2.2 cm × 1.3–1.6 cm, those in the proximal two-thirds with vestigial spines, distal ones with stiff, pointed spines to 1.3 cm long. Female cones more or less ovoid, 11–15 cm × 6–8 cm, green; peduncle 10–28 cm × 1.2–1.6 cm, elliptical in cross-section, furrowed; megasporophylls with stipe 1.6–2.3 cm long, the outer face transversely elliptical to transversely ovate, 2.5–3.5 cm × 1.2–1.5 cm, with a prominent depression just below the apical spine; spines increasing in length towards the apex of the cone, the longest c. 4 cm long. Seeds oblong to ovoid, 1.9–2.6 cm × 1.8–2.2 cm, the sarcotesta orange to red when ripe. **Figs 3, 10B.**

Specimens examined: Queensland. BURNETT DISTRICT: [all from type locality or near Eidsvold] Nov 1984, *Forster* 1952 (BRI); Aug 1988, *Forster* 4659 (BRI); 4674 (BRI); Jan 1992, *Forster* 9384A & *Machin* (BRI, CBG); May 1992, *Jones* 9363, *Jones & Forster* (CBG); Sep 1992, *Forster* 11197A & *B et al.* (BRI); Aug 1993, *Halford* 1791 (BRI).

Distribution and habitat: *M. crassifolia* occurs in two small areas near Mundubbera and Eidsvold in south-east Queensland. Plants grow at altitudes between 340 and 420 m among granite rocks and boulders on rugged slopes under open forest dominated by *Allocasuarina inophloia* (F. Muell. & F.M. Bailey) L.A.S. Johnson, *Eucalyptus dura* L.A.S. Johnson & K.D. Hill, *E. petalophylla* Brooker & A.R. Bean, *E. trachyphloia* F. Muell., *E. watsoniana* F. Muell. and *Lysicarpus angustifolius* (Hook.) Druce.

Phenology: Cones mature October–January; seeds ripen February–April.

Notes: *M. crassifolia* was first collected in 1984 by the junior author, at which stage it was considered to be an aberrant form of *M. pauli-guilielmi*. Further collections have revealed it to differ from that species in having much thicker-textured, darker green leaflets, male cones with prominent apical spines on the upper sporophylls (very short or vestigial in *M. pauli-guilielmi*) and larger female cones.

Conservation status: Known from 6 populations all on private land within two restricted areas, but locally common. A conservation coding of R was given by Forster (1994).

Etymology: The epithet derives from the Latin *crassus*, thick and *folium*, a leaf, in reference to the thick leaflets of the species.

4. *Macrozamia machinii* P. I. Forst. & D. L. Jones *sp. nov.* *M. plurinerviae* (L.A.S. Johnson) D. L. Jones affinis, sed foliolis textura crassiore in paginis ambobus obscure atro-viridibus, strobilis minoribus

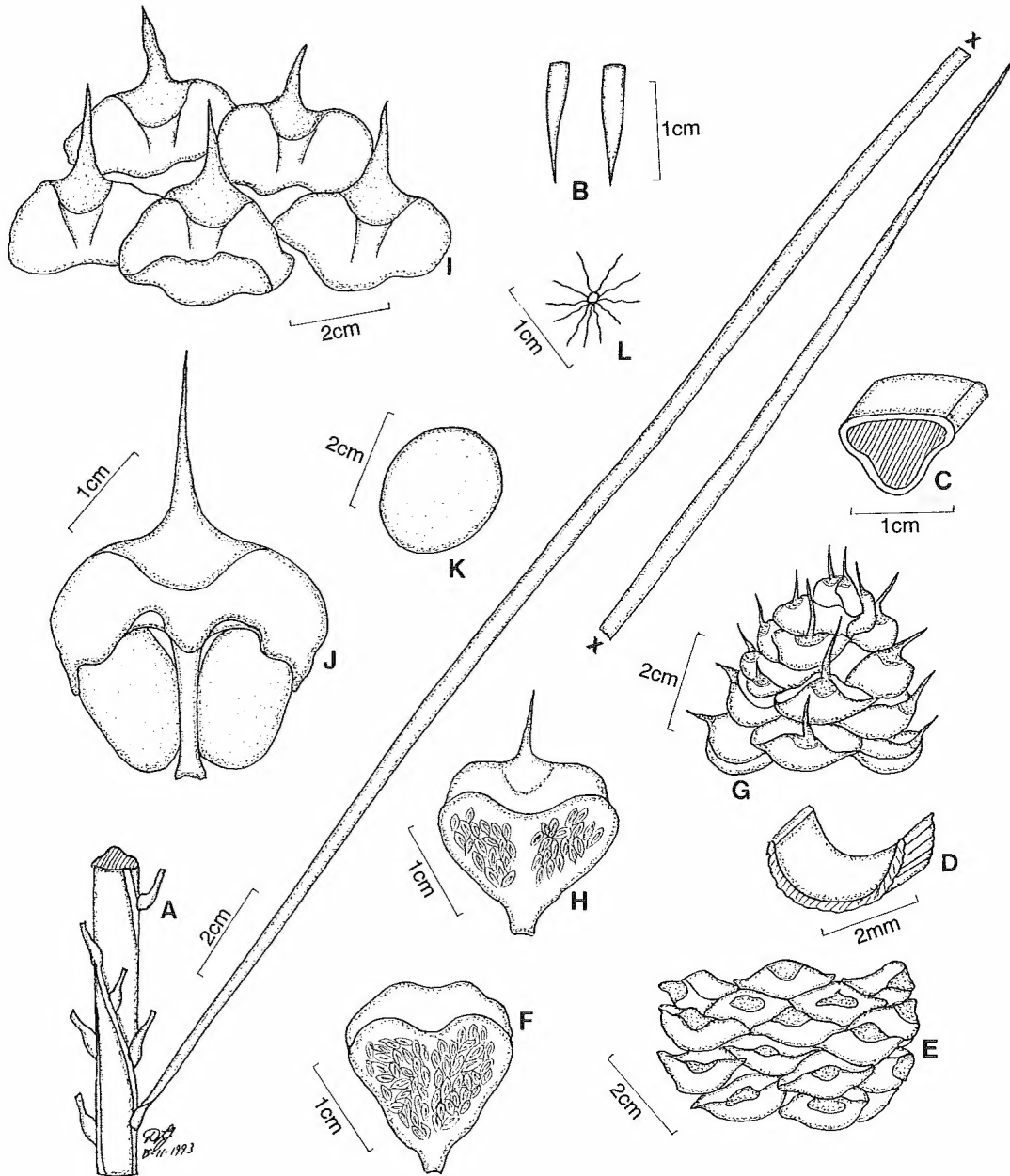


Fig. 3. *Macrozamia crassifolia*. A. portion of rhachis and one leaflet. B. tips of leaflets. C. TS of rhachis. D. TS of leaflet. E. basal portion of male cone. F. microsporophyll (abaxial view) from basal portion of cone. G. apical portion of male cone. H. microsporophyll (abaxial view) from apical portion of cone. I. portion of female cone. J. megasporophyll (abaxial view). K. seed. L. pattern on chalaza end of seed. From Jones 9363 *et al.* (CBG) and Forster 9384B & Machin (BRI).

viridibus, et seminibus minoribus oblongis usque ovoideis, differt. **Typus:** Queensland. DARLING DOWNS DISTRICT: Inglewood, 11 Apr 1992, *P.I. Forster* 9767B & *P. Machin* [male plant] (holo: BRI [4 sheets + carpological]; iso: CBG).

Macrozamia sp. (Inglewood *C.T. White* AQ142073); Forster (1994).

Caudex more or less ovoid, 20–30 cm diameter, branching with up to 10 caudices in a clump. Young leaves sericeous. Mature leaves 60–90 cm long, dark green, dull, erect, 1–8 in a sparse to dense crown; expanded leaf base 5–10 cm × 2–3.5 cm, densely covered with soft, grey wool; petiole (including the expanded woolly base) 13–21 cm long, green to yellow-green, dull, 9–14 mm across at the lowest leaflet, flat to slightly convex on the adaxial surface and strongly convex abaxially; rhachis spirally twisted 2–6 times, green to yellow-green, dull, the cross-section similar to that of the petiole. Leaflets linear, arising at about 50 degrees to the rhachis, obliquely erect to spreading, 8–32 cm × 2.5–10 mm, hypo-stomatic, dark green and dull on both surfaces, concave adaxially in cross-section, thick-textured, not twisted except at the base, 80–140 per leaf, arranged more or less in 2 ranks but not always in opposite pairs, moderately crowded (3–35 mm apart), the longest leaflets towards the middle of the frond, distal and proximal leaflets shorter, apex asymmetrically acuminate; callous base yellow to orange or reddish, the colour frequently extending along the rhachis margin between the leaflets. Male cones more or less cylindrical, 8–20 cm × 4–6 cm, straight or curved with age; peduncle 9–15 cm × 1.5–2.2 cm, elliptical in cross-section, furrowed; microsporophylls narrowly- to broadly cuneate or obovate, 1.5–2.4 cm × 1.2–2.4 cm, those in the proximal third to half of the cone with vestigial spines, distal ones with stiff, pointed spines to 1.4 cm long. Female cones ovoid to ovoid-cylindrical, 8–18 cm × 5–7 cm, erect, green to glaucous; peduncle 15–25 cm × 1.3–1.8 cm, elliptical to round in cross-section, furrowed; megasporophylls with stipe 2–2.5 cm long, the outer face transversely ovate, 2.5–5 cm × 1.5–2 cm, with a prominent depression just below the apical spine; spines

increasing in length towards the apex of the cone, the longest c. 2 cm long. Seeds oblong to ovoid, 2–2.5 cm × 2–2.3 cm, the sarcotesta orange to red when ripe. **Figs 4, 8A, 9A, 10C.**

Selected specimens: Queensland. DARLING DOWNS DISTRICT: [all from type locality] Nov 1922, *White* [AQ142073] (BRI); Apr 1992, *Forster* 9767A & *Machin* (BRI, CBG); 9782 (BRI, CBG); 9783A & B (BRI, CBG); 9787 (BRI, CBG); 9790A (BRI), 9790B (BRI, CBG); 9794 (BRI); May 1992, *Jones* 9445 & *Jones* (CBG); Sep 1992, *Forster* 11631 & *Machin* (BRI); April 1993, *Jones* 11527 *et al.* (CBG, NSW); Oct 1993, *Machin* 27A & B (BRI); Oct 1993, *Halford* Q1978A & B (BRI).

Distribution and habitat: *M. machinii* occurs in at least eight populations near Inglewood in the Darling Downs district, south-east Queensland. Most populations occur in sandy soils in flat areas of open forest dominated by *Angophora leiocarpa* (L.A.S. Johnson & G.J. Leach) K.R. Thiele & Ladiges, *Allocasuarina inophloia*, *Callitris glaucophylla* Joy Thompson & L.A.S. Johnson, *Lysicarpus angustifolius* and *Acacia conferta*; however, one population occurs on a red lateritic ridge with *Callitris endlicheri* (C.Parl.) F.M. Bailey, *Eucalyptus panda* S.T. Blake and *E. apothalassica* L.A.S. Johnson & K.D. Hill. Altitude of the populations ranges from 320 to 460 m.

Phenology: Cones mature September–December; seeds ripen February–April.

Notes: This species appears to have been first collected in 1922 by C.T. White but was not relocated until 1991 by Peter Machin. *M. machinii* has been confused with *M. plurinervia* but differs from that species by its thicker leaflets which are dull green on both surfaces (grey-green to glaucous in *M. plurinervia*), smaller cones and smaller, oblong to ovoid seeds (broadly ovoid to oblong-ellipsoid in *M. plurinervia*). These taxa grow in different habitats, with *M. plurinervia* occurring in hilly country with large granite outcrops prominent and gravelly loam soils, whereas *M. machinii* grows in flat plains and breakaways on deep sandy soils.

Conservation status: Most populations of this species occur in State Forests, however, plants may be subject to poaching. A conservation coding of R was given by Forster (1994).

Etymology: Named for Peter Machin, whose unstinting enthusiasm and interest in the cycads has been catalytic in this work progressing so rapidly.

5. *Macrozamia occidua* D. L. Jones & P. I. Forst. sp. nov. *M. cranei* D. L. Jones & P. I. Forst. affinis, sed foliis multo brevioribus, petiolo et rhachidi angustiore, foliolis brevioribus apicibus dentatis, et strobilis femineis glaucis, differt.

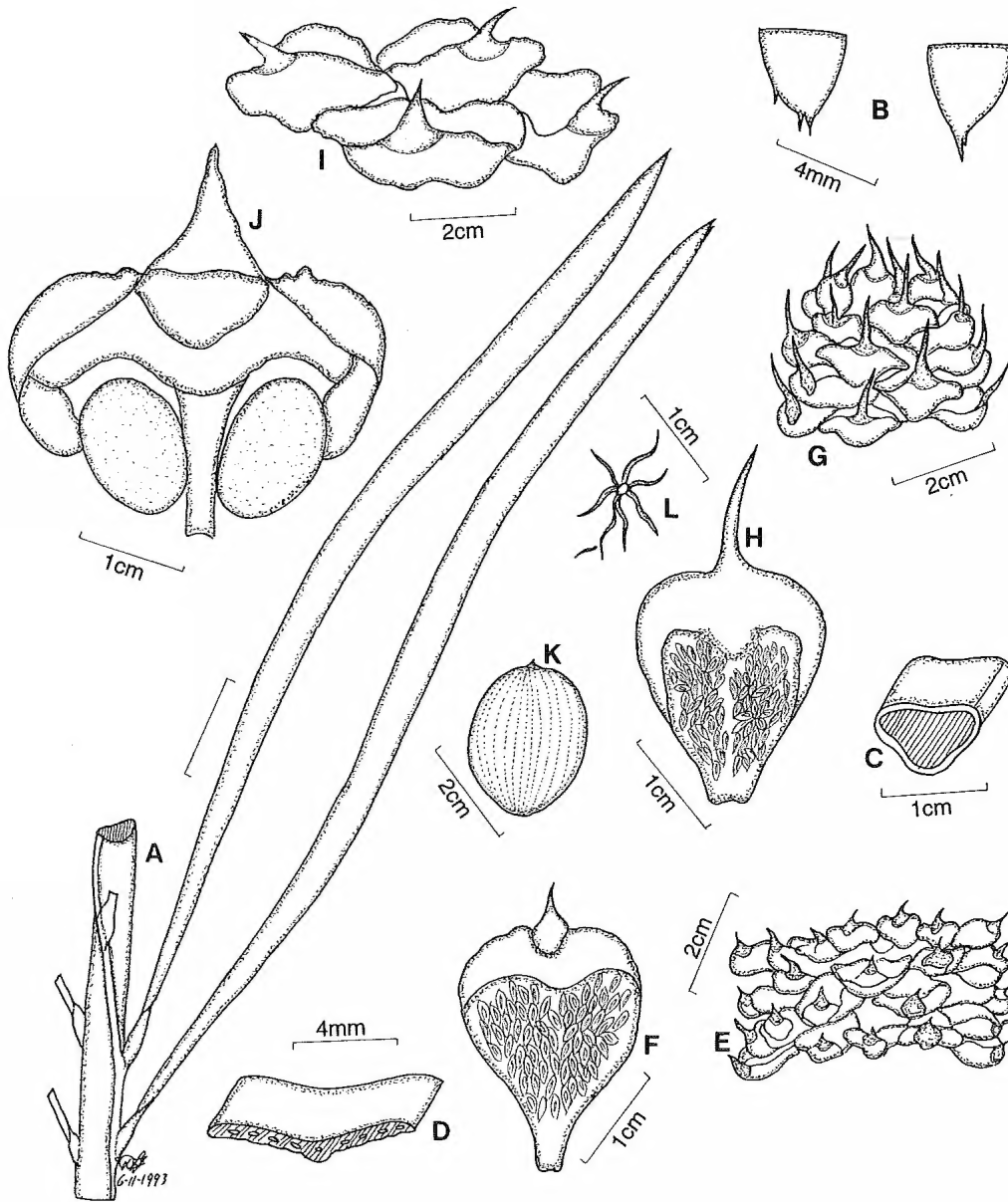


Fig. 4. *Macrozamia machinii*. A. portion of rhachis and two leaflets. B. tips of leaflets. C. TS of rhachis. D. TS of leaflet. E. basal portion of male cone. F. microsporophyll (abaxial view) from basal portion of cone. G. apical portion of male cone. H. microsporophyll (abaxial view) from apical portion of male cone. I. portion of female cone. J. megasporophyll (abaxial view). K. seed. L. pattern on chalaza end of seed. From Jones 9445 & Jones (CBG).

Typus: Queensland, DARLING DOWNS DISTRICT: Sundown National Park, 8 Jan 1993, *P.I. Forster* 12663B & *P. Machin* [male plant] (holo: BRI [2 sheets & carpological]; iso: CBG).

Caudex more or less ovoid, 10–20 cm diameter, subterranean, not branching. Mature leaves 40–75 cm long, dark green, erect, 1–5 in an obliquely erect, sparse crown; expanded leaf base 5.5–9.0 cm × 1.5–2.5 cm, densely covered with fawn to grey-green, soft wool; petiole (including the woolly expanded base) 10–25 cm long, dark green, 6–10 mm across at the lowest leaflet, flat adaxially and strongly convex abaxially; rhachis spirally twisted 2–4 times, dark green, the cross-section similar to that of the petiole. Leaflets linear, arising at about 60 degrees to the rhachis, obliquely erect to spreading, 6–20 cm × 3–10 mm, hypo-stomatic, dark green above, glaucous-pruinose beneath, concave adaxially in cross-section, not twisted except at the base, 80–120 per frond, arranged more or less in 2 ranks but not always in opposite pairs, crowded (3–24 mm apart), the longest leaflets towards the middle of the frond, distal and proximal leaflets shorter, apex acuminate, sometimes bidentate or tridentate; callous base greenish-yellow to yellow, rarely pink. Male cones more or less cylindrical, 10–24 cm × 3.5–5 cm, straight, glaucous; peduncle 8–15 cm × 1.6–2 cm, round in cross-section, smooth to irregularly furrowed; microsporophylls cuneate to broadly cuneate, 1.5–2.5 cm × 1–1.7 cm, the majority of the microsporophylls with vestigial apical spines, distal ones with stiff, pointed spines to 0.5 cm long. Female cones ovoid, 10–14 cm × 5–7 cm, glaucous; peduncle 6–16 cm × 1.2–1.6 cm, round to elliptical in cross-section, furrowed; megasporophylls with stipe 2–2.5 cm long, the outer face transversely elliptical to transversely ovate, 2–3 cm × 1–1.3 cm, with a prominent sunken area just below the apical spine; spines increasing in length towards the apex of the cone, the longest *c.* 2 cm long. Seeds ellipsoid, 1.8–2.5 cm × 1.5–2 cm, the sarcotesta orange to red when ripe. **Fig. 5.**

Selected specimens: Queensland, DARLING DOWNS DISTRICT: [all from type locality], Oct 1990, *Hazelgrove* s.n. (*Jones* 6765) (CBG); Jan 1993, *Forster* 12663A & *Machin* (BRI, CBG); Jan 1993, *Forster* 12683A & *Machin* (BRI), 12683B (BRI, CBG); Apr 1993, *Jones* 11519 *et al.* (CBG, NSW).

Distribution and habitat: Known from two populations in Sundown National Park, south-east Queensland. Plants grow in sandy soil derived from acid-intermediate volcanics of greywacke and mudstone (traprock) in open forest dominated by *Eucalyptus prava* L.A.S. Johnson & K.D. Hill and *E. sideroxylon* A. Cunn. & Woolls. Associated species include *Dampiera purpurea* R. Br., *Goodenia delicata* Carolin, *Hibbertia stricta* (DC.) R. Br. ex F. Muell., *Podolepis arachnoidea* (Hook.) Druce, *Persoonia sericea* A. Cunn. ex R. Br., *Olearia microphylla* (Vent.) Maiden & Betche, *Leucopogon muticus* R. Br., *L. melaleucoides* A. Cunn. ex DC., *Brachyloma daphnoides* (Sm.) Benth. and *Melichrus urceolatus* R. Br.

Phenology: Cones mature September–January; seeds ripen February–April.

Notes: This species was discovered by Peter Hazelgrove, National Parks Ranger at Sundown National Park. It is closest to *M. cranei* but differs from that species by its shorter leaves, shorter, dull leaflets and glaucous female cones. Whereas *M. occidua* grows in open forest on traprock, *M. cranei* is associated with limestone outcrops in open forest or semi-evergreen vinethicket.

Conservation status: Although all populations occur in a National Park, some poaching pressures are expected; we suggest a coding of VC.

Etymology: The epithet derives from the Latin *occiduus*, going down, setting, an oblique reference to the Sundown country where the type specimen was collected.

6. *Macrozamia parcifolia* P. I. Forst. & D. L. Jones, **sp. nov.** *M. pauli-guilielmi* W. Hill & F. Muell. *affinis*, sed foliis angustioribus, obscure atro-virentibus, textura tenui, in rhachidi subangulo acutiore insertis, differt. **Typus:** Queensland, WIDE BAY DISTRICT: Biggenden, 5 Jan 1992, *P.I. Forster* 9318B & *P. Machin* [male plant] (holo: BRI [2 sheets, carpological & spirit]; iso: CBG).

Macrozamia sp. (Biggenden P.I. Forster 12301B); Forster (1994).

Caudex more or less ovoid, 10–20 cm diameter, subterranean, not branching. Young leaves light green, glabrous. Mature leaves 65–95 cm long, dark green, erect, 1–4 in a very sparse

crown; petiole (including the woolly expanded base) 15–30 cm long, 6–9 mm across at the lowest leaflet, dark green, dull, slightly concave abaxially, strongly convex adaxially; rhachis

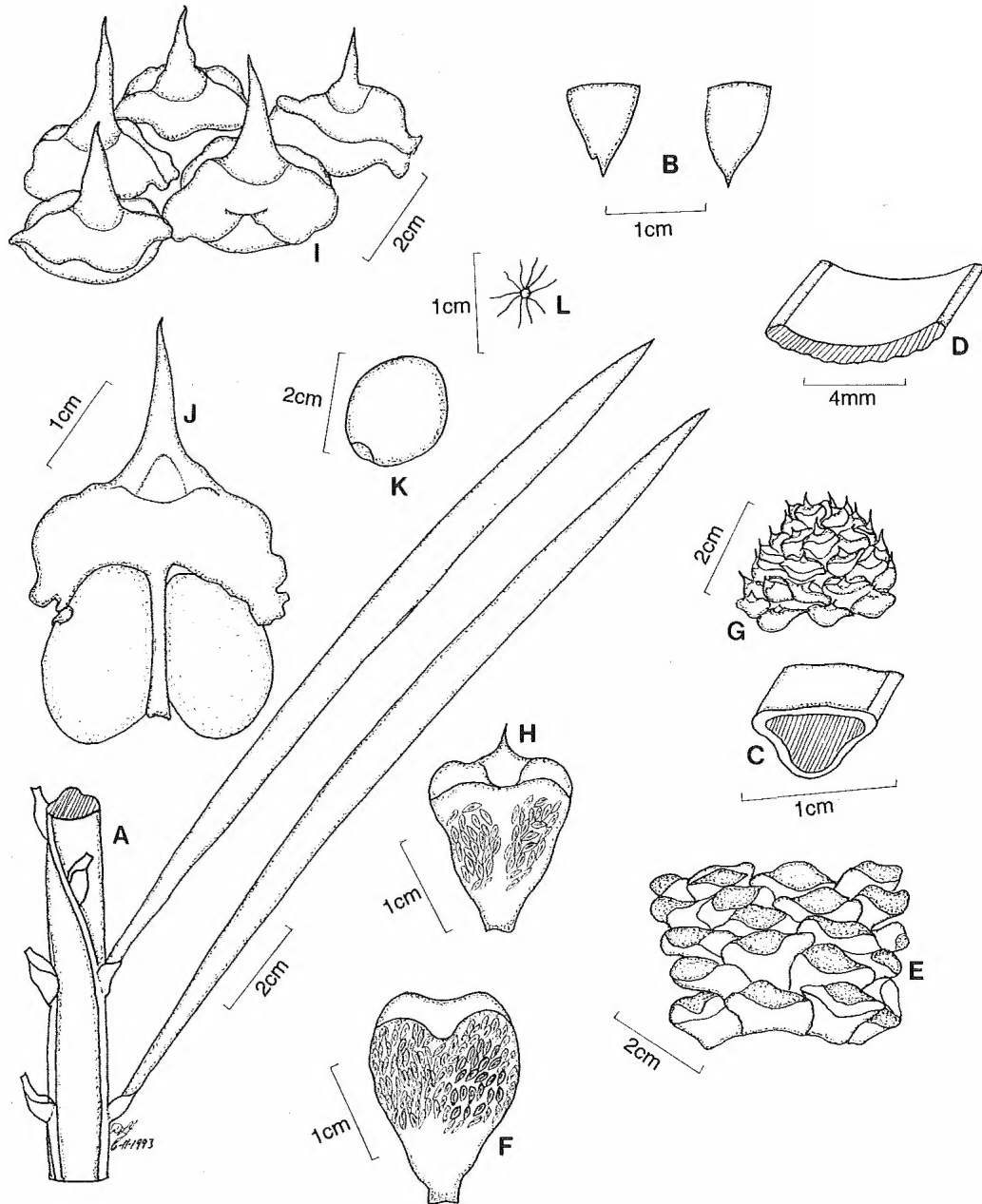


Fig. 5. *Macrozamia occidua*. A. portion of rhachis and two leaflets. B. tips of leaflets. C. TS of rhachis. D. TS of leaflet. E. basal portion of male cone. F. microsporophyll (abaxial view) from basal portion of cone. G. apical portion of male cone. H. microsporophyll (abaxial view) from apical portion of cone. I. portion of female cone. J. megasporophyll (abaxial view). K. seed. L. pattern on chalaza end of seed. From Jones 11519 & et al. (CBG) and Forster 12663A & Machin (BRI).

spirally twisted 2–6 times, dark green with greenish-white markings between the bases of the leaflets but not in a continuous band, the cross-section similar to that of the petiole. Leaflets very narrowly linear, arising at about 30 degrees to the rachis, obliquely erect to arcuate, lax to drooping in the distal half to third, 15–40 cm × 1–3 mm, hypostomatic, dark green and dull above, bright green beneath, strongly concave adaxially in cross-section, thin-textured, spirally twisted 1–3 times, 100–220 per leaf, arranged more or less in 2 ranks but not always in opposite pairs, not crowded (5–25 mm apart), the longest leaflets towards the middle of the leaf, distal and proximal leaflets shorter, apex acuminate; callous base greenish-white, obscure. Male cones more or less cylindrical, 7–14 cm × 2.5–4 cm, usually curved with age; peduncle 6–12 cm × 0.6–1.2 cm, elliptical in cross-section; microsporophylls broadly cuneate to broadly obovate or nearly orbicular, 1.2–1.8 cm × 1.2–1.7 cm, those in the proximal half to two-thirds of the cone with vestigial spines, distal ones with stiff, pointed spines to 1.5 cm long. Female cones ovoid to ovoid-cylindrical, 8–14 cm × 4–6 cm, erect; peduncle 13–18 cm × 0.6–1 cm, elliptical in cross-section, smooth; megasporophylls with stipe 1.5–2 cm long, the outer face transversely ovate, 2–2.7 cm × 1–1.4 cm, with a prominent depression just below the apical spine; spines increasing in length towards the apex of the cone, the longest c. 2.8 cm long. Seeds ovoid, 1.7–2.5 cm × 1.5–2.0 cm, ovoid, the sarcotesta orange to red when ripe. **Fig. 6.**

Selected specimens: Queensland. WIDE BAY DISTRICT: [all from type locality or near Biggenden], Dec 1992, *Forster* 12569 & *Machin* (BRI, CBG); Feb 1993, *Forster* 13107 & *Machin* (BRI); Dec 1991, *Forster* 9260A&B (BRI, CBG); Jan 1992, *Forster* 9318A (BRI, CBG); May 1992, *Jones* 9361, *Jones & Forster* (CBG, MEL, NSW); Jun 1993, *Forster* 13322 (BRI).

Distribution and habitat: *M. parcifolia* is known from three localities in the Wide Bay district near Biggenden. It grows on hard red-brown clay loams of basaltic origin on ridges and in tall open forest dominated by *Eucalyptus citriodora* Hook. and *E. fibrosa* F. Muell., with a shrubby understorey of *Jacksonia scoparia* R. Br. and *Psychotria daphnoides* A. Cunn., at altitudes between 180 and 220 m.

Phenology: Cones mature October–January; seeds ripen February–April.

Notes: Although obviously related to *M. pauli-guilielmi*, *M. parcifolia* can be immediately distinguished from that species by its narrower, thinner-textured, darker green leaflets which are attached to the rachis at a steeper angle. In addition the callous base of its leaflets is greenish white and obscure in comparison to the prominent cream to white callous base of *M. pauli-guilielmi*. *M. parcifolia* has the narrowest and thinnest leaflets of any member of the *M. pauli-guilielmi* complex, giving its leaves an untidy and wispy appearance. The two species occupy different habitats with *M. pauli-guilielmi* being restricted to coastal lowland wallum in heath or woodland on deep siliceous sands.

Conservation status: One population is mainly within a National Park, whereas the other two occur in State Forests. A conservation coding of R was given by Forster (1994).

Etymology: The epithet derives from the Latin *parcus* frugal, thrifty, scanty and *folium*, a leaf; an allusion to the slender, wispy leaves.

7. *Macrozamia viridis* D. L. Jones & P. I. Forst. **sp. nov.** *M. plurinerviae* (L.A.S. Johnson) D. L. Jones affinis, sed habitu minore, foliis brevioribus proportione latioribus, prasinis, nitentibus, strobilis multo minoribus, et seminibus minoribus, differt. **Typus:** Queensland. DARLING DOWNS DISTRICT: Wyberba, 7 Jan 1993, *P.I. Forster* 12634B & *P. Machin* [male plant] (holo: BRI [1 sheet & carpological]; iso: CBG).

Macrozamia sp. (Wyberba S.T. Blake 4646); Forster (1994).

Caudex more or less ovoid, 10–20 cm diameter subterranean, branching with up to 6 caudices in a clump. Mature leaves 35–60 cm long, dark green and shiny, spreading, 1–5 in a sparse crown; expanded leaf base 4.5–10 cm × 1.5–2.2 cm, densely covered with dense, soft, fawn wool; petiole (including the woolly expanded base) 9–21 cm long, dark green, shiny, 8–14 mm across at the lowest leaflet, flat to slightly convex adaxially and strongly convex abaxially; rachis spirally twisted 1–3 times, dark green, shiny, the cross-section similar to

that of the petiole. Leaflets broadly linear, arising at about 60 degrees to the rachis, obliquely erect to spreading, 7–20 cm × 3–11 mm, hypostomatic, dark green and shiny

above, green beneath, concave adaxially in cross-section, moderately thick-textured, not twisted except at the base, 80–160 per frond, arranged more or less in 2 ranks but not always in oppo-

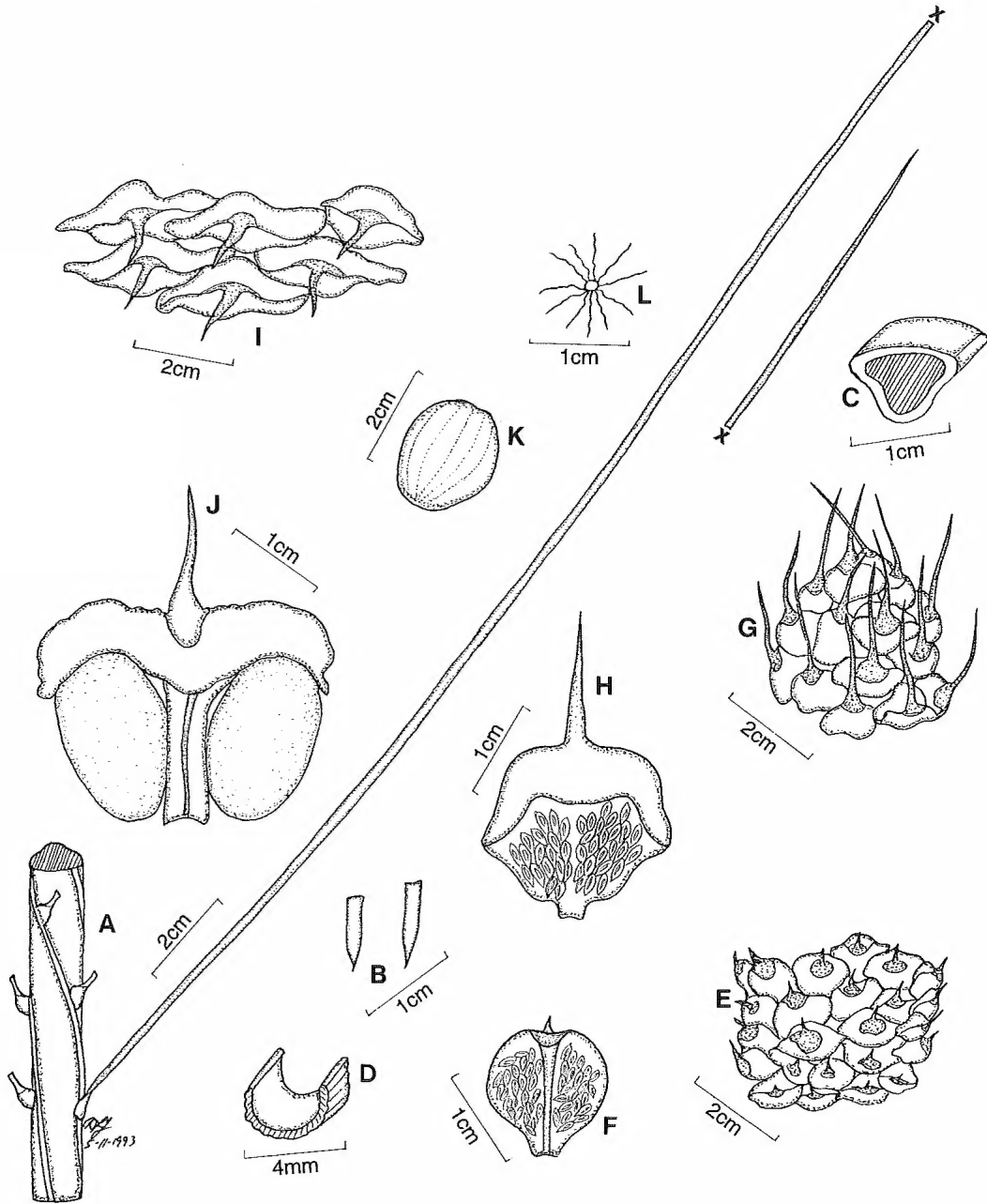


Fig. 6. *Macrozamia parcifolia*. A. portion of rhachis and one leaflet. B. tips of leaflets. C. TS of rhachis. D. TS of leaflet. E. basal portion of male cone. F. microsporophyll (abaxial view) from basal portion of cone. G. apical portion of male cone. H. microsporophyll (abaxial view) from apical portion of cone. I. portion of female cone. J. megasporophyll (abaxial view). K. seed. L. pattern on chalaza end of seed. From Jones 9361 & et al. (CBG) and Forster 9318B & Machin (BRI).

site pairs, crowded (2–20 mm apart), the longest leaflets found towards the middle of the leaf, distal and proximal leaflets shorter, apex acute to acuminate; callous base yellowish-white to reddish-orange. Male cones more or less cylindrical, 9–18 cm × 3.5–5 cm, straight or slightly curved with age; peduncle 8–15 cm × 1.5–2 cm, round in cross-section, shallowly furrowed; microsporophylls cuneate to broadly cuneate, 1.5–2 cm × 1.2–1.8 cm, those in the proximal third to half with vestigial spines, distal ones with stiff, pointed spines to 1.5 cm long. Female cones ovoid, 8–14 cm × 5.5–7 cm; peduncle 12–16 cm × 1.5–2 cm, elliptical in cross-section, furrowed; megasporophylls with stipe 2–2.5 cm long, transversely elliptical to ovate, the outer face 3–5.0 cm × 1–1.5 cm, with a prominent, small sunken depression just below the apical spine; spines increasing in length towards the apex of the cone, the longest c. 1.5 cm long. Seeds broadly oblong-ovoid, 1.7–2.3 cm × 2–2.4 cm, the sarcotesta orange to red when ripe. **Fig. 7.**

Selected specimens: Queensland. DARLING DOWNS DISTRICT: Wyberba, Jan 1933, *Blake* 4646 (BRI); Jan 1993, *Forster* 12634A & *Machin* (BRI, CBG); Girraween N.P., Jan 1993, *Forster* 12642A&B & *Machin* (BRI); ditto, Apr 1993, *Jones* 11520 *et al.* (CBG, NSW).

Distribution and habitat: Known from the Girraween - Wyberba area in the south of the Darling Downs district. Plants grow in deep granitic sand in open eucalypt forest which has prominent, large granite outcrops and pavements. Associated plants include *Brachyloma daphnoides*, *Bossiaea rhombifolia* Sieber ex DC. subsp. *rhombifolia*, *Stylidium graminifolium* Sw., *Brachyscome microcarpa* F. Muell., *Leucopogon melaleucoides* A. Cunn. ex DC., *Platysace ericoides* (Sieber ex Spreng.) C. Norman and *Persoonia tenuifolia* R. Br.

Notes: *Macrozamia viridis* was first collected in 1933 by S.T. Blake at Wyberba. It is a very distinctive species related to *M. plurinervia* but with a dwarf habit, much shorter fronds with shiny, bright green leaflets, much smaller cones and smaller seeds.

Phenology: Cones mature October–January; seeds ripen March–April.

Conservation status: Of restricted distribution being known from only two populations, with one in Girraween National Park. A conservation coding of V was given by Forster (1994).

Etymology: Derived from the Latin *viridis*, green, in reference to the green leaflets.

Key to species of *Macrozamia* section *Parazamia* in Queensland

1. Leaves held more or less horizontal; rhachis abruptly curved near the base; leaflets held more or less erect ***M. platyrachis*** F.M. Bailey
Leaves erect to obliquely erect; rhachis straight or gently curved; leaflets spreading 2
2. Leaflets 1–4 mm across 3
Leaflets 5 mm across or more 5
3. Leaflets 1–3 mm across, thin-textured, arising at about 30 degrees to the rhachis ***M. parcifolia*** P. I. Forst. & D. L. Jones
Leaflets 2–4 mm across, thick-textured, arising at about 45 degrees to the rhachis 4
4. Leaflets very thick-textured, dark green; male cones with prominent apical spines to 1.3 cm long on the upper sporophylls ***M. crassifolia*** P. I. Forst. & D. L. Jones
Leaflets moderately thick-textured, mid-green to pale green; male cones with very short apical spines to 3mm long on the upper sporophylls or spines absent ***M. pauli-guilletmi*** W. Hill & F. Muell.
5. Leaflets glaucous-pruinose beneath (obvious when young) 6
Leaflets green, never glaucous-pruinose beneath 7

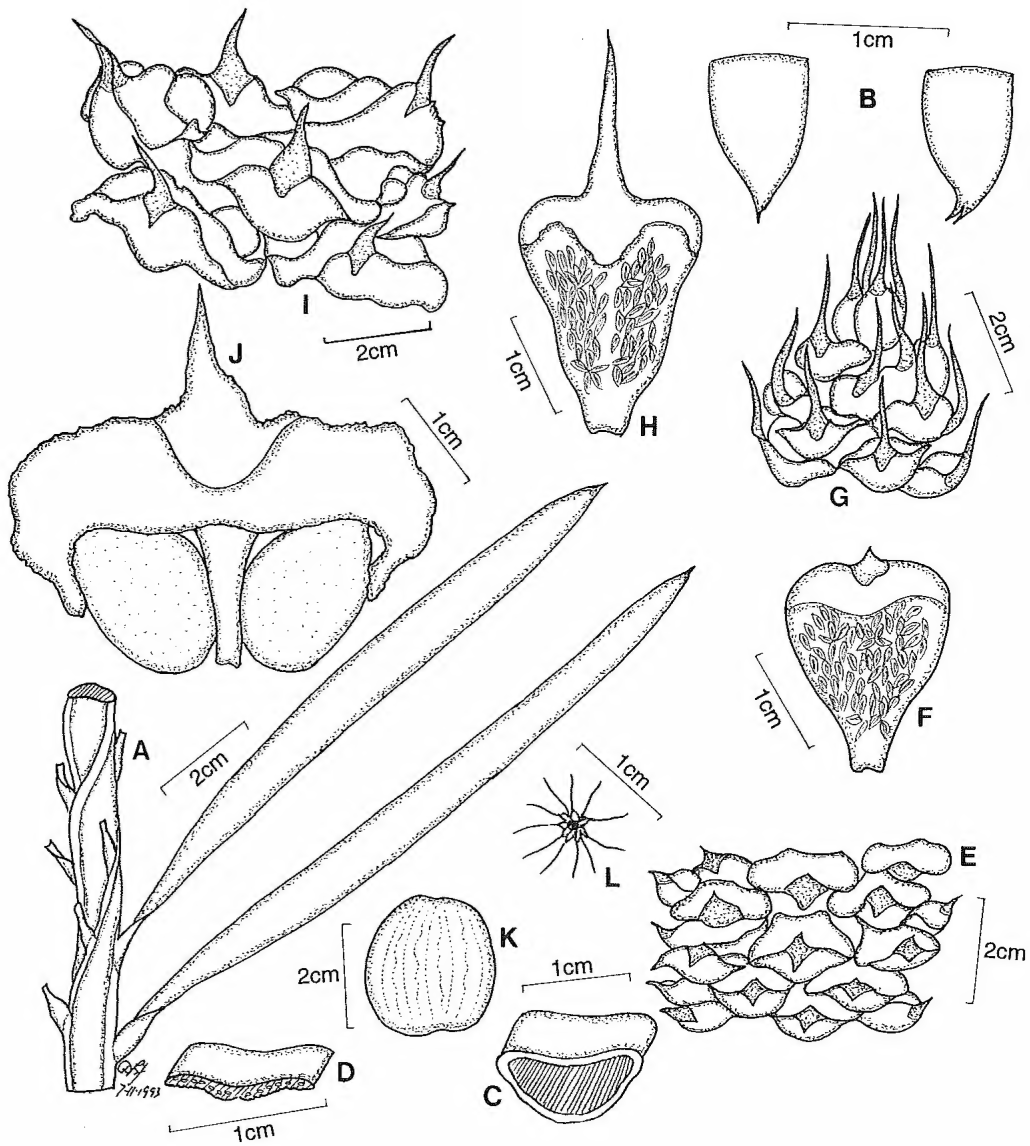


Fig. 7. *Macrozamia viridis*. A. portion of rhachis and two leaflets. B. tips of leaflets. C. TS of rhachis. D. TS of leaflet. E. basal portion of male cone. F. microsporophyll (abaxial view) from basal portion of cone. G. apical portion of male cone. H. microsporophyll (abaxial view) from apical portion of cone. I. portion of female cone. J. megasporophyll. K. seed. L. pattern on chalaza end of seed. From Jones 11520 & *et al.* (CBG).

6. Leaves 40–75 cm long; leaflets dull above, 6–20 cm long; cones glaucous
 **M. *occidua*** D. L. Jones & P. I. Forst.
 Leaves 70–90 cm long; leaflets shiny above; cones green, never glaucous
 **M. *cranei*** D. L. Jones & P. I. Forst.
7. Leaflets deeply concave adaxially in cross-section 8
 Leaflets nearly flat in cross-section or shallowly concave adaxially 9
8. Leaflets crowded, 7–21 cm × 2–6 mm **M. *conferta*** D. L. Jones & P. I. Forst.
 Leaflets widely separated, 20–60 cm × 6–11 mm **M. *fearnsidei*** D. L. Jones
9. Leaflets shiny **M. *viridis*** D. L. Jones & P. I. Forst.
 Leaflets dull 10
10. Leaflets crowded, stiffly erect **M. *lomandroides*** D. L. Jones
 Leaflets widely spaced, obliquely erect to spreading ... **M. *machinii*** P. I. Forst. & D. L. Jones

Acknowledgements

We are very grateful for the enthusiasm and continuing assistance of Peter Machin in locating and revisiting various populations. Ralph Crane, Peter Hazelgrove and staff at Girraween National Park respectively brought *M. cranei*, *M. occidua* and *M. viridis* to our attention and arranged for visits to their localities. Corinna Broers and Barbara Jones provided competent technical assistance and Alex George provided the Latin diagnoses. The Queensland Forest Service supplied permits to collect botanical specimens and to traverse State Forests and Timber Reserves. A number of private land-owners tolerated their 'rickets bush' populations being examined and we respect their wish to remain anonymous.

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Fig. 8. Examples of *Macrozamia* habitats. A. habitat of *M. machinii* (Forster 9787 & Machin). B. habitat of *M. conferta* (Forster 11705 & Machin).



Fig. 9. Examples of *Macrozamia* habit. A. *M. machinii*, male plant (Forster 9787 & Machin). B. *M. cranei*, male plant (Forster 11619 et al).

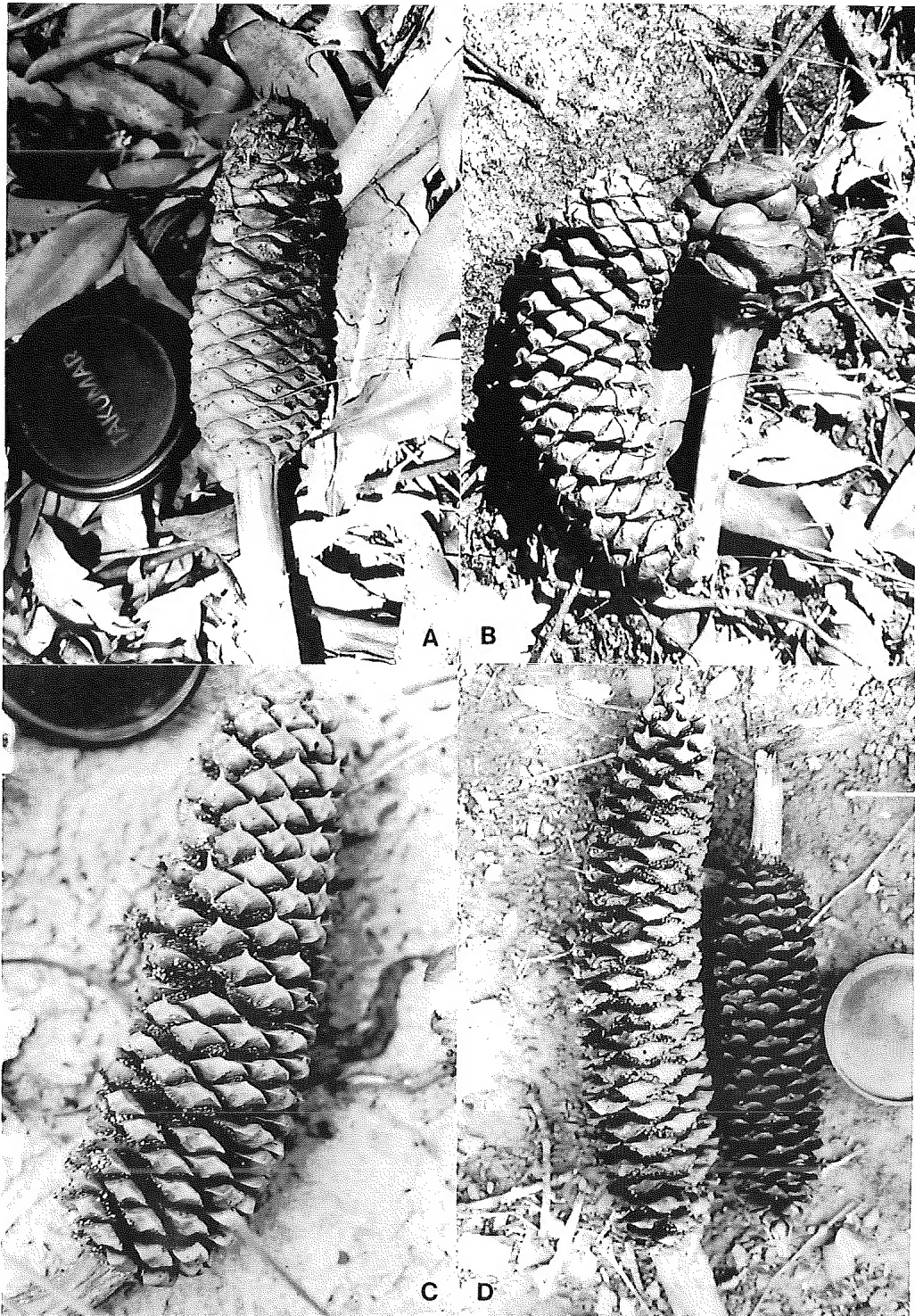


Fig. 10. Examples of *Macrozamia* cones. A. *M. parvifolia*, male cone (Forster 9318 & Machin). B. *M. crassifolia*, male and female cone (Forster 9384 & Machin). C. *M. machinii*, male cone (Forster 9787 & Machin). D. *M. cranei*, male cones (Forster 11593 et al).